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ABSTRACT

Two experiments were conducted to investigate the development of evaluative and taxonomic encoding in children's memory. The task used was a modification of the Wickens short-term memory task in which subjects' recall of words is tested following a distraction task. The first experiment found that 11-year-old children, but not 8-year-old children, encoded words using the evaluative dimension of the semantic differential. In the second experiment, both 7- and 11-year-old children demonstrated the ability to encode words according to taxonomic categories. These findings were related to other recent work on the development of memory. (Author/SET)

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EVALUATIVE AND TAXONOMIC ENCODING IN CHILDREN'S MEMORY

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Abstract

Two experiments were conducted to investigate the development of evaluative and taxonomic encoding in children's memory. The task used was a modification of the Wickens short-term memory task in which subjects' recall of words is tested following a distraction task. The first experiment found that 11 year old children, but not 8 year old children, encoded words using the evaluative dimension of the semantic differential. In the second experiment, both 7 and 11 year olds demonstrated the ability to encode words according to taxonomic categories. These findings were related to other recent work on the development of memory.

EVALUATIVE AND TAXONOMIC ENCODING IN CHILDREN'S MEMORY

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Recent research in memory has indicated that the developing child increasingly utilizes cognitive and verbal skills, such as rehearsal (Hagen & Kail, 1973), clustering (Appel, Cooper, McCarell, Sims-Knight, Yussen & Flavell, 1972) and the use of indirect cues (Ritter, Kaprove, Fitch & Flavell, 1973), in the storage and retrieval of information. However there is comparatively little evidence on the development of the dimensions of encoding in memory. Wickens (1970) investigated the dimensions adults use to encode in memory, and found that semantic dimensions (e.g. taxonomic categories) were very important, while the physical characteristics of the word were of less importance.

The task used by Wickens was a modification of the Brown-Peterson short-term memory task. A trial consists of presentation of the to-be-remembered items, then a brief distraction task, followed by a test for recall. If the items are selected from a common class, performance declines rapidly over trials, due to the build up of proactive inhibition (PI). However,if the items presented on a later trial shift to a different class, a "release from PI" effect is evident, resulting in increased recall in comparison to a control group which does not change material. PI accumulates because the homogeneous items are encoded similarly in memory. The improvement in recall or "release effect" is due to the fact that the words on the shift trial are encoded differently in memory, thus resulting in less interference (Wickens, 1970). Further, Gardiner, Craik and Birtwistle (1972) presented evidence indicating that recall declines over trials because the retrieval cues provided by the common category name become less effective. Increases in performance on the shift trial indicate that the novel items have provided a new and more effective retrieval cue.

Cermak, Sagotsky and Moshier (1972) studied the ability of second, fourth, and sixth grade subjects to use the evaluative dimensions of the semantic differential in memory encoding. Only the sixth graders demonstrated both an accumulation and release of PI, indicating the ability to encode along the evaluative dimensions employed in this study. Cermak et al. hypothesized three stages in the development of evaluative encoding ability. However because the recall of the second and fourth grade subjects did not decline systematically over trials, indicating the build up of PI, interpretation of these data is problematic. Recent work by Cann, Liberty, Shafto, and Ornstein (1973), in which seven year olds' recall declined over trials but improved following shifts between consonants and digits, indicates that the Wickens task can be used with younger children and suggests that some other variable, such as word difficulty, may have been confounded in the Cermak study.

However, there is an additional problem with the Cermak experiment which may have influenced the results. The positive and negative words used by Cermak et al. were listed by Osgood, Tannenbaum and Suci (1957) as end points of scales which measure the evaluative dimensions of the semantic space. While such word pairs as <u>end points of scales</u> may measure the evaluative dimension of the semantic space, this does not mean that when presented <u>individually</u> they necessarily load heavily on the evaluative dimension themselves. For example, "fair" may tap the positive end of the evaluative dimension when presented with "unfair," but clearly may take on an entirely different meaning when presented alone, e.g. a carnival. Heise (1965) presented 1000 common words individually and had subjects rate them on all three major dimensions of the semantic space. Nine of the ten positive words used as stimuli in the Cermak study were measured by Heise (1965). The mean standard score ratings of these words on the three dimensions were evaluative, 0.89; activity, 0.05; potency, -0.81. Thus the

positive words used in the Cermak study confounded moderately low values on the potency dimension with moderately high scores on the evaluative dimension. Consequently, it is difficult to make any clear statements about the development of evaluative encoding ability from this study.

Experiment I further investigated the development of evaluative encoding in children. Children at two age levels, eight and eleven years, were tested on the Wickens task, with shifts occurring between words valued positively and negatively on the evaluative dimension. Words were selected from the scales compiled by Heise (1965).

EXPERIMENT I

METHOD

Subjects

Subjects were 50 second and third graders, and 50 fifth and sixth graders from Spencer Elementary School, Whitmore Lake, Michigan. All subjects were white and came from lower-middle to middle-class homes. Twenty-five children at each age level were arbitrarily assigned to each of four experimental groups: Younger shift (CA=8 yr., 1 mo.); younger nonshift (8 yr., 9 mo.); older shift (11 yr., 7 mo.); older nonshift (11 yr., 4 mo.). There was approximately an equal number of boys and girls in each group.

Materials

The words selected for this study from the scales compiled by Heise (1965) are presented in Table 1. Words were chosen to maximize evaluative values and

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Insert Table 1 here

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minimize scores on the other scales; in general the words chosen had a standard score of one or more on the evaluative dimension, and less than one on the other

two dimensions. In addition, attempts were made to minimize reading difficulty for the younger children, as well as acoustic and associative similarity. The word dyads were printed in one inch block letters on 4 x 6 inch white index cards. For the distractor task, 2 x 3 inch colored patches were mounted on 4 x 6 inch index cards. Presentation rate was paced with a continuously running stopwatch.

Procedure

The subject sat across a small table from the experimenter. The subject first saw a ready signal (a card with an asterisk) for two seconds, followed by a word dyad for two seconds. The subject read the words aloud as the card was shown, and was prompted if he failed to do so. Then the subject named the colored patches as they were shown to him. Colors were presented at the rate of one patch per second for fifteen seconds. Following the color naming task, the subject had ten seconds in which to recall the two words presented on that trial.

The subject was first given a practice trial. In order to minimize interference with the word dyads, the stimuli were two digits. Five test trials followed the practice trial, with a six second interval between trials. Color cards were randomly reordered during this period. For the subjects in the shift groups, the word class was shifted on the fifth trial. Half of the subjects in the shift groups were tested with positive words on the first four trials, then shifted to negative words on the fifth trial; the remaining subjects shifted from negative to positive words. For the nonshift groups, half of the subjects were tested with positive word dyads exclusively, while the other half were tested with the negative word dyads. Word dyads were counterbalanced so that each dyad appeared equally often in each trial position.

All subjects were tested individually in a room within the school by a white male experimenter. Each experimental session lasted approximately ten minutes.

Results

Figure 1 depicts the mean percentage of correct responses as a function of trials for the two age groups and shift and nonshift groups. The scores of three

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Insert Figure 1 here

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subjects in the younger shift group who did not meet the criterion of one correct response in the first two trials were deleted from the data analyses and replaced by the means for that condition, a procedure suggested by Lindquist (1956). A three way analysis of variance computed for the age, condition, and trials (repeated measure) variables yielded only a significant trial effect, $F(4,384) = 13.98$, $p<.001$. Thus for both age and shift groups recall declined systematically over trials. There were no other significant main effects, nor were there any significant interactions.

Comparisons between the means for shift and nonshift groups on trial five indicated no differences for the eight year olds, $t(48)<1$, while this difference approached significance for the eleven year olds, $t(48)=1.63$, $p<.1$. Inspection of the recall scores for the eleven year olds in Figure 1 suggests that the marked improvement by the shift group on the fifth trial was partially obscured by the nonshift group's higher performance on trial four. t tests measuring the difference between performance on trials four and five yielded a significant improvement for the shift group, $t(24)=2.47$, $p<.05$, and no change for the nonshift group, $t(24)<1$. Thus only the recall of the older children improved on the shift trial, indicating that the eleven year olds, but not the eight year olds, used the evaluative dimension to encode the word dyads.

EXPERIMENT II

The results of Experiment I present two important findings. First, the Wickens task can be used to determine the encoding dimensions used by children as young as seven years. All groups of children demonstrated a systematic decline in recall over trials, attributable to the accumulation of PI. Second, the general findings of Cermak et al. (1972) were replicated. While there were no overall age differences in recall, there were developmental differences in the ability to utilize the evaluative dimension of the semantic differential as an encoding category in memory.

To examine further the applicability of the Wickens task for the study of memory encoding in children, Experiment II investigated the development of taxonomic encoding. Children at two age levels, seven and eleven years, were assigned to shift and nonshift groups and tested on the Wickens task. In adults encoding by taxonomic class is the most effective type of semantic encoding (Wickens, 1970). Consistent with previous developmental memory research, it was thus predicted that the performance of the older children should resemble that of adults, with a strong improvement in recall on the shift trial. Research on the use of taxonomic categories in clustering in free recall tasks (e.g. Appel et al. 1972) suggests that the younger children should demonstrate less, if any, improvement in recall on the shift trial.

METHOD

Subjects

Subjects were 34 second and 34 fifth graders from St. Mary's School in Delaware, Ohio. Most subjects were white and came from lower-middle to middle class homes. Seventeen children, with approximately the same number of boys and girls, were assigned to each of the four groups: Younger shift (CA=7 yr., 5 mo.); younger nonshift (7 yr., 6 mo.); older shift (10 yr., 6 mo.); older norshift (10 yr., 7 mo.).

Materials

The words used in this experiment were selected from My Self Help Dictionary, commonly used by first and second graders. Eight words were chosen from each of two categories, body parts and four-legged animals, with efforts to minimize acoustic similarity and associations between word pairs. Words were printed in one inch block letters on 5 x 7 inch white index cards. For the distractor task, colored patches similar to those in Experiment I were centered on 5 x 7 inch index cards. All time intervals were measured with a metronome.

Procedure

With a few modifications, the procedure from Experiment I was also used in this study. There were four rather than five test trials. Thus the fourth trial was the shift trial in this experiment. Shifts were again made in both directions, with half the children shifting from animal words to body part words, the other half from body parts to animals. Nonshifting subjects were tested with either all animal or body part word dyads.

Results

The mean percentages of words recalled as a function of trials for both age levels and shift conditions are presented in Figure 2. A three way analysis of variance for age. shift condition, and trial (repeated measure) factors was per-

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Insert Figure 2 here

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formed on these data. The older children recalled significantly more words than the younger children, $F(1,64)=6.73$, $p<.05$. As predicted, performance declined over trials, $F(3,192)=8.75$, $p<.01$, and there was a significant shift condition x trials interaction, $F(3,192)=10,19$, $p<.01$. It is evident in Figure 1 that the recall of the shift groups at both age levels improved on the shift (fourth) trial,

while the nonshift groups' performance continued to decline. Comparisons of recall on the fourth trial indicated a significant difference between the shift and nonshift groups at both age levels [younger: ($t(32)=3.69$, $p<.01$; older: $t(32)=2.92$, $p<.01$], thus indicating taxonomic encoding by both younger and older children. There were no other significant main effects or interactions.

Discussion

In both experiments the development of encoding processes in children was investigated. It is clear that the Wickens technique can be used effectively to study the development of encoding processes in memory in children as young as seven years. In Experiment I older children, but not younger, utilized the evaluative dimension of the semantic space as an encoding category. Experiment II demonstrated that both seven and eleven year old children are capable of encoding words using taxonomic classes.

Apparently the ability to use evaluative classes in memory develops sometime after the ability to correctly place words in evaluative categories. DiVesta (1966) demonstrated that seven year olds can accurately classify words into positive and negative categories of the evaluative dimension, yet in Experiment I the younger children did not utilize these categories as retrieval cues, lending support to Cermak's idea of developmental differences in the ability to encode along the evaluative dimension. It is not clear, however, from these data why older children can utilize these dimensions to aid recall. They may have a richer semantic network in which to encode items or their improvement in recall on the shift trial may reflect more sophisticated retrieval strategies.

These findings are also consistent with much of the recent literature on the development of memory, which has emphasized the lack of cognitive differentiation in the younger child's memory. However, from Experiment II, it appears

that seven year olds use different taxonomic classes as encoding classes in memory and can use these category names to facilitate recall. This is particularly interesting in light of the Appel et al. (1972) finding that younger children demonstrated little use of taxonomic categories in a free recall task, as measured by the amount of clustering. These findings may suggest further differences in the development of acquisition, encoding, and retrieval processes.

Such differences would be supported by recent Soviet developmental memory research. Smirnov and Zinchenko (1969) reported on children's ability to group materials to aid recall. They suggested that there is a distinction between the conscious and unconscious grouping of stimuli in memory tasks. "Thus on the conscious level...semantic grouping (is) inadequately grasped...At the same time, in an unconscious form, grouping by content is widespread...Before becoming a conscious process, intelligent grouping occurs in unconscious form..." (Smirnov & Zinchenko, 1969, p. 479.) As a child learns new taxonomic categories, these provide additional semantic structures in memory for word encoding. Because the words presented on the shift trial are encoded differently, by a process that is primarily involuntary, recall for these words improves. Conversely, clustering is an active process requiring the child to recall first category names and then the contents of those categories. Clustering involves the conscious grouping of stimuli, while performance on the Wickens task is clearly less dependent on such active grouping and presumably relies heavily upon existing semantic structures in memory.

Appel et al. (1972) suggest that memory development consists in large part of the increasing ability to employ various cognitive subroutines in order to improve memory. It would appear that differential encoding of stimuli according to various classes is important early in the development of memory. Further, these findings indicate that taxonomic encoding may be one of the first processes to become effective in the young child's memory.

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TABLE 1

RATINGS OF WORD DYADS USED IN EXPERIMENT I ON EVALUATIVE, ACTIVITY, AND POTENCY DIMENSIONS OF THE SEMANTIC SPACE (from Heise, 1965)

Positive words	Evaluative	Activity	Potency
Fresh	1.60	-.38	-.68
save	1.11	.87	-.19
true	1.23	.41	-.35
home	1.80	1.29	-1.81
good	1.03	-.27	-.51
live	1.22	.83	.14
open	1.15	-.27	.25
nice	1.76	-1.28	-1.42
church	2.21	-.77	-.66
milk	1.38	-.96	.15
$\bar{X}$=	1.45	-.05	-.51
Negative words			
bad	-3.35	-.79	.50
hate	-3.11	.11	-.61
kill	-3.29	.98	-.27
cut	-1.88	.95	-.67
fall	-2.17	-.04	-.65
worry	-2.20	.25	-1.64
burn	-2.47	.74	-.52
no	-2.09	.27	.37
fear	-2.25	-.05	-.99
cold	-2.41	.05	1.39
$\bar{X}$=	-2.52	-.25	-.31

Footnote

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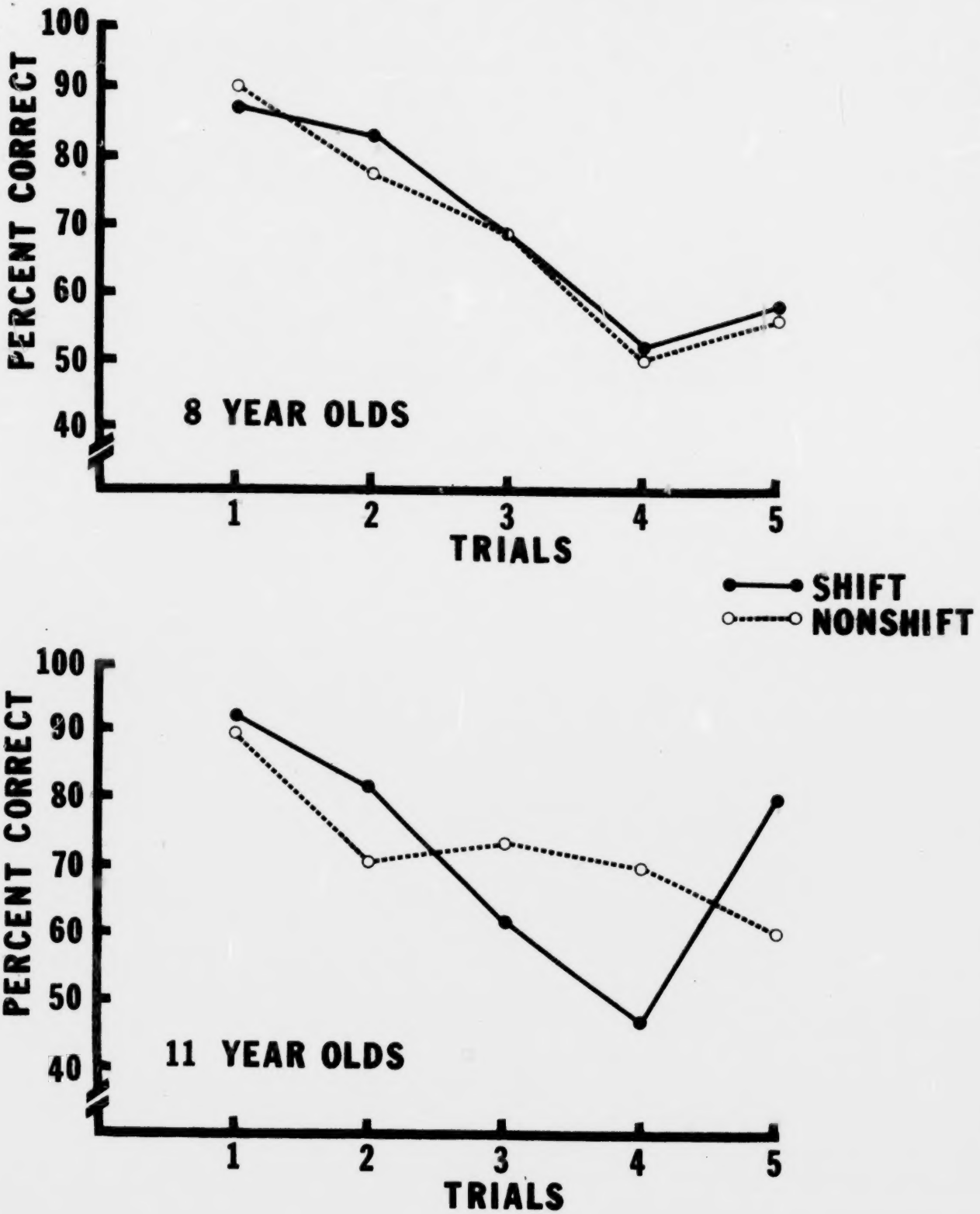
Figure captions

Figure 1. Percent correct for shift and nonshift subjects at both levels in Experiment I.

Figure 2. Percent correct for shift and nonshift groups at both age levels in Experiment II.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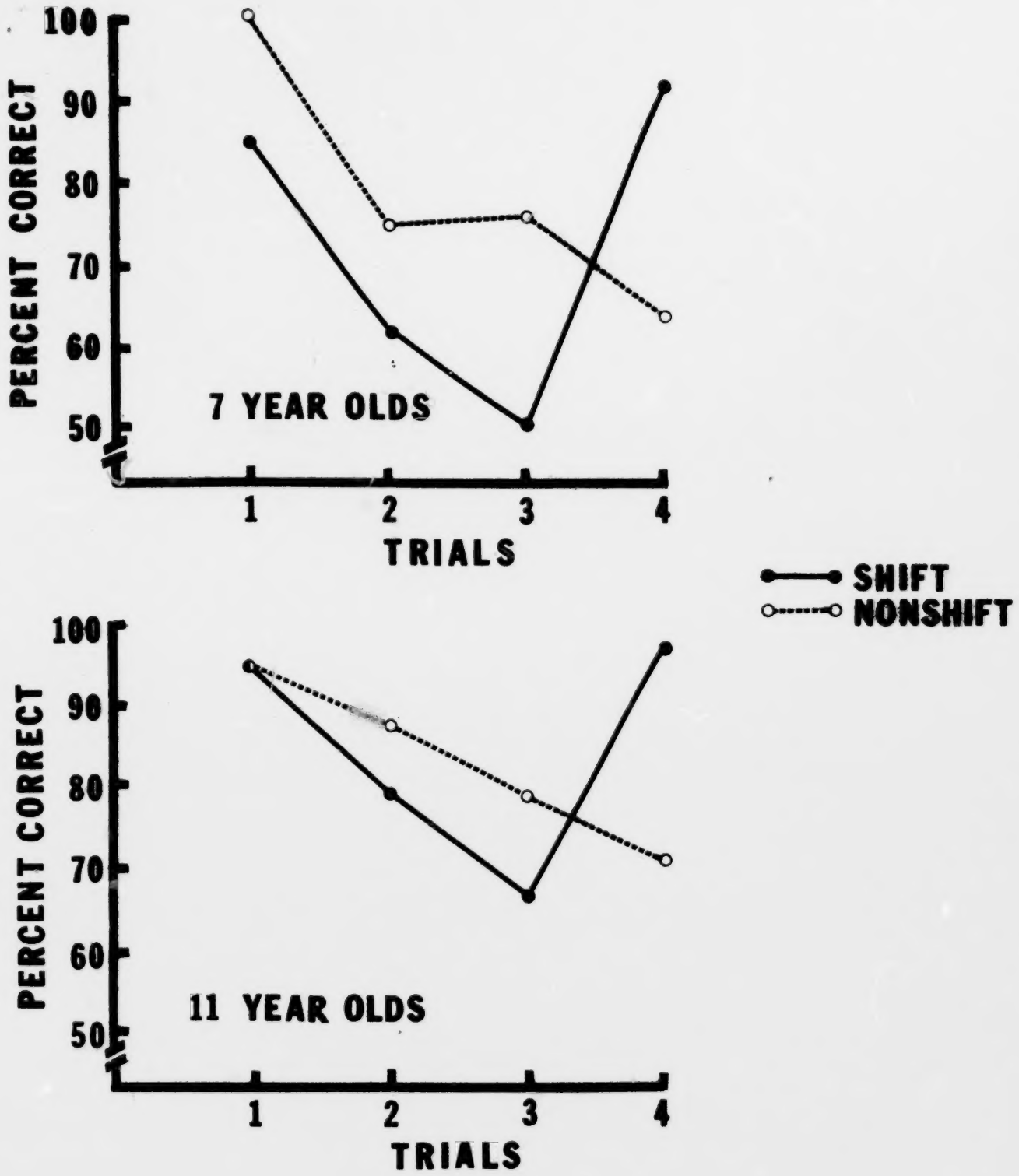
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